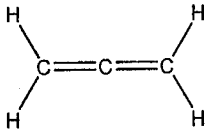
Uva Wellassa University, Sri Lanka
End Semester Examination – March 2011
SCT 332 – 3 Materials Chemistry – II
Time: Three (03) hours

This paper consist of two parts: Part – A and Part – B.
Total **six (06)** questions
Answer **five (05)** questions only
Question 01, 05 and 06 are compulsory
Answer **03** questions from Part – A including question 01 and answer **all** questions in Part - B

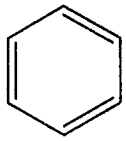
## PART – A

01) List all the symmetry elements in each molecule; hence deduce the point group to which these molecules belong.

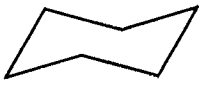
a. $C_3H_4$



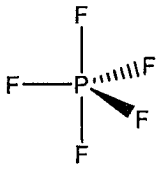
b. Benzene



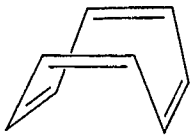
c. Cyclohexane



d. $PF_5$



e. Cyclooctatetraene



(100 marks)

02) a. Asbestos mineral come from two different groups of silicates, name them.
b. Draw the general structure of one of the groups you mention in (a) above.
c. State two commercial importance of asbestos minerals.
d. Though asbestos is chemically inert, it presents a series of health hazard. Name one of them.
e. i. Briefly explain the bonding in diborane.
ii. According to the structure of borane they can be classified into four groups. Name three of them.
iii. Draw the structure of the following boranes.
(1) $B_7H_7$
(2) $B_6H_{10}$

(50 marks)

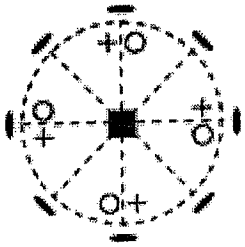
03) a. Draw stereographic projections of two of the following point groups.

i. $C_{3h}$

ii. $D_{3h}$

iii. $D_{4h}$

b. The stereographic projection of a point group is given bellow.



i. Deduce the symmetry elements in this group.

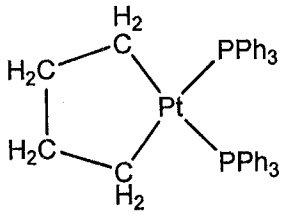
ii. State the point group to which this stereographic projection belongs to.

iii. Sketch a shape of a possible molecule belongs to this point group.

(50 mar

04) a. Write the IUPAC name of the following organometallic compounds.

i. $[OsEt(NH_3)_5]$ Cl

ii. 


b. Draw the structure of the following organometallic compounds and determine the haptocity of the ligands

i [(phenylethynyl)(pyridine)bis(triphenylphosphane)rhodium]

ii carbonyl($\eta^5$-cyclopentadienyl)[(E)-3phenylbut-2-en-2yl](triphenylphosphane)ir

c. Describe the bonding between a metal and an alkenyl group (eg. –C≡CR) in organometallic compound.

d. Account for the variation in C=C stretching frequencies in the following compounds

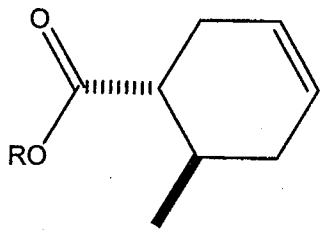
| Compound | ν (C=C) in $cm^{-1}$ |
|---|---|
| Free $CH_2$=$CH_2$ | 1623 |
| $[Ag(\eta^2\text{-}CH_2{=}CH_2)_2]BF_4$ | 1584 |
| $[CpRh(\eta^2\text{-}CH_2{=}CH_2)_2]$ | 1493 |

(50 m

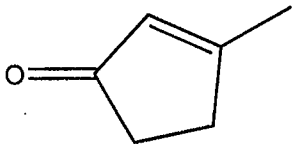
## PART - B

05) By applying retrosynthetic analysis, give a reasonable synthetic route for any <u>four</u> of following molecules. **Clearly indicate retrosynthetic analysis and synthetic routes.**

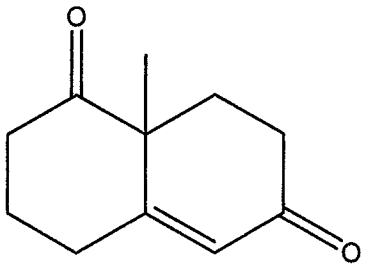
a.



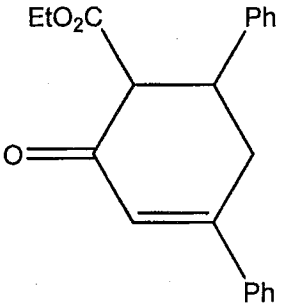

b.



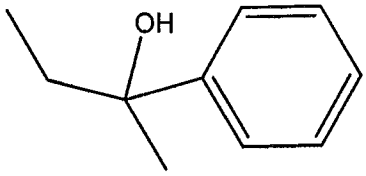

c.



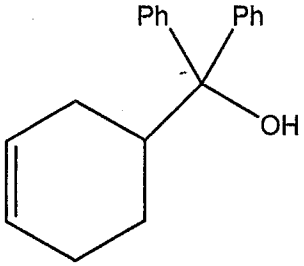

d.




e.




f.




(50 marks)





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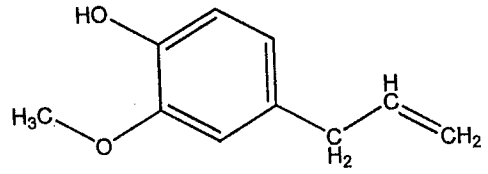
06) Some of the data obtained from NMR spectrums of compound A ($C_{10}H_{12}O_2$) are given bellow. Assign all the $^1$H-NMR signals and $^{13}$C-NMR signals.




Compound A

$^1$H-NMR spectrum – eight signals

| δ/ ppm | No of H responsible | Multiplicity |
|---|---|---|
| 3.21 | 2H | triplet of a doublet |
| 3.83 | 3H | singlet |
| 4.99 | 2H | triplet of a doublet |
| 5.35 | 1H | singlet |
| 5.92 | 1H | triplet of a triplet |
| 6.62 | 1H | doublet |
| 6.72 | 1H | doublet |
| 6.84 | 1H | singlet |

$^{13}$C-NMR spectrum- ten signals

39.8, 56.1, 111.3, 115.5, 115.9, 122.7, 133.5, 136.5, 145.7 and 147.4

DEPT

Signals at δ 111.3, 115.5, 122.7 and 136.5 were due to CH carbon atoms
Signal at δ 115.9 was due to $CH_2$ carbon atoms

COSY

Correlations between $^1$H-NMR signal at 6.62 and 6.72.

HMQC correlations

| $^1$H-NMR signal | $^{13}$C-NMR signal |
|---|---|
| 5.92 | 136.5 |
| 6.62 | 122.7 |
| 6.84 | 111.3 |

HMBC 2-and 3-bond correlation

| $^{13}$C-NMR signal | $^1$H-NMR signal |
|---|---|
| 133.5 | 3.21, 5.92, 6.62, 6.72 and 6.84 |
| 122.7 | 3.21 |
| 145.7 | 6.62 |

(50 marks)